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PRELIMINARY STUDIES AND REPORT

SANITARY SEWER COLLECTION AND TREATMENT FACILITIES

BIG SKY OF MONTANA, INC.

AUGUST, 1970

MORRISON - MAIERLE, INC.
Consulting Engineers
HELENA —— BILLINGS —— BOZEMAN
MONTANA

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PART I

BASIS OF DESIGN

1.01 GENERAL:

The quantity and quality of sanitary sewage collected and treated must be determined for proper design of the collection and treatment facilities. The development proposed at Big Sky provides a somewhat different situation in determining basis of design than a normal community due to the recreational type activity.

Similar recreational developments in Western United States, as well as planners and engineers in this field, were contacted for information in determining criteria for basis of design. Also, a report entitled "Basic Waste Characteristics At Winter Recreation Areas" published by the Northwest Regional Office of the Federal Water Quality Administration, was most helpful.

The basis of design of a sewer system must also consider the period of time for which it is to be designed. While it is good practice to design for future needs, consideration has to be given to the expected rate of development and the economics involved in providing for future needs.

Sewer pipe lines such as collection laterals, interceptors and outfall lines are usually designed for ultimate development. Sewage treatment plants, pump stations, and other mechanical installations, are designed for a somewhat lesser period with provisions for expanding to ultimate capacity at a future date. It has been suggested by the planning group that the treatment facilities for the Big Sky project be initially designed and constructed for projected development about midway between the "First Phase" and Ultimate Programs.

1.02 POPULATION:

The following population figures for First Phase and Ultimate development are summarized from data furnished by David Jay Flood & Associates. Population figures under the column entitled "Design" are an approximate average of First Phase and Ultimate figures and will be used as a basis of design for initial treatment plant construction.

TABLE I - POPULATION

MOUNTAIN VILLAGE.

	Winter Population-Max. Day @ Full Occupancy		
	Ultimate	First Phase	Design
Residents			
Hotels (2 capita per room)	1,000	200	600
Condominiums (4 capita per unit)	2,400	800	1,600
Houses (5 capita per unit)	750	250	500
Employees	450	200	325
TOTAL	4,600	1,450	3,025
Non-Residents			
Skiers (weekend day)	750	250	500
Employees	630	190	410
TOTAL	1,380	440	910

	Summer Population - Max. Day Occupancy Predicted		
	Ultimate	First Phase	Design
Residents			
Hotels	900	200	550
Condominiums	150	100	125
Houses	75	25	50
Employees	340	125	235
TOTAL	1,465	450	960
Non-Residents			
Convention Center	100	100	100
Employees	125	45	85
TOTAL	225	145	185

MEADOW VILLAGE.

	Winter Population - Max. Day Occupancy Predicted		
	Ultimate	First Phase	Design
Residents			
Condominiums	400	120	260
Houses	1,600	50	825
Misc. Commercial	135	15	75
TOTAL	2,135	185	1,160
Non-Residents			
Miscellaneous	10	0	10

MEADOW VILLAGE - Continued

	Summer Population - Max. Day @ Full Occupancy		
	Ultimate	First Phase	Design
Residents			
Condominiums	1,200	240	720
Houses	1,800	250	1,025
Misc. & Commercial	50	35	45
TOTAL	3,050	525	1,790
Non-Residents			
Guests & Golfers	100	50	75
Commercial	150	50	100
TOTAL	250	100	175

1.03 QUANTITY OF SEWAGE:

Actual sewage flows will be slightly less than the water consumption of a community or development, not including irrigation. A consumptive loss of 20 percent is commonly used.

A survey of several recreational areas in Western United States similar to Big Sky indicated a wide variety of average per capita water and sewage flows. The best source of information on water and sewage flows is contained in a study and report prepared by B. David Clark of the Federal Water Quality Administration entitled "Basic Waste Characteristics At Winter Recreation Areas". This report is a result of studies conducted at Crystal Mountain, Timberline Lodge and Bachelor Butte resorts in the States of Washington and Oregon.

Using data from the above report and a consumptive loss of 20 percent, the following per capita sewage contributions were established:

Overnight Residents, including hotels, condominiums,

houses and employees ----------------------------------60 gpcd

Day visitors, skiers and non-resident employees--------10 gpcd

(gpcd = gallons per capita per day)

The above per capita contributions include allowances for meals and other miscellaneous uses. These figures correspond very closely to the design criteria suggested by Webster-Martin Engineers as follows:

Condominiums - - - - - 50 gpcd

Day Skiers - - - - - - 6 gpcd

Restaurants - - - - - -- 3 gallons per meal served.

Following in Table II is a tabulation of estimated daily sewage flows using population projections presented in Table I and the above contributions of 60 gpcd for residents and 10 gpcd for non-resident visitors, skiers and employees.

TABLE II - MAXIMUM DAILY SEWAGE FLOWS

MOUNTAIN VILLAGE.

Winter - Max. Day @ Full Occupancy

	First Phase	Design	Ultimate
Residents	1450 capita	3025 capita	4600 capita
	@ 60 = 87,000gpd	@ 60 = 181,500gpd	@ 60 = 276,000gpd
Non-Res.	440 capita	910 capita	1380 capita
	@ 10 = 4,400gpd	@ 10 = 9,100gpd	@ 10 = 13,800gpd
	TOTAL 91,400gpd	TOTAL 190,600gpd	TOTAL 289,800gpd

Summer - Max. Day

	First Phase	Design	Ultimate
Residents	450 capita	960 capita	1465 capita
	@ 60 = 27,000gpd	@ 60 = 57,600gpd	@ 60 = 87,900gpd
Non-Res.	145 capita	185 capita	225 capita
	@ 10 = 1,450gpd	@ 10 = 1,850gpd	@ 10 = 2,250gpd
	TOTAL 28,450gpd	TOTAL 59,450gpd	TOTAL 90,150gpd

MEADOW VILLAGE.

Winter - Max. Day

	First Phase	Design	Ultimate
Residents	185 capita	1160 capita	2135 capita
	@ 60 = 11,100gpd	@ 60 = 69,600gpd	@ 60 = 128,100gpd
Non-Res.	---------	10 capita	10 capita
		@ 10 = 100gpd	@ 10 = 100gpd
	TOTAL 11,100gpd	TOTAL 69,700gpd	TOTAL 128,200gpd

Summer - Max. Day @ Full Occupancy

	First Phase	Design	Ultimate
Residents	525 capita	1790 capita	3050 capita
	@ 60 = 31,500gpd	@ 60 = 107,400gpd	@ 60 = 183,000gpd
Non-Res.	100 capita	175 capita	250 capita
	@ 10 = 1,000gpd	@ 10 = 1,750gpd	@ 10 = 2,500gpd
	TOTAL 32,500gpd	TOTAL 109,150gpd	TOTAL 185,500gpd

(gpd = Gallons Per Day)

The above sewage flows are maximum daily flows expected at each village for the season indicated. Such flows are used as a basis of design for sizing the sewage treatment facilities, but are not the average daily flows for the development. To get the average annual or seasonal daily flow, one must estimate occupancy rates for the total facilities. Dividing the winter and summer seasons into 6 months each, the sewage productions are estimated in Table III.

TABLE III - SEASONAL AND ANNUAL SEWAGE PRODUCTION AND ANNUAL AVERAGE DAILY FLOWS

MOUNTAIN VILLAGE.

	Winter Season (Oct. through March)		
Maximum Day	1st Phase 91,400 gpd	Design 190,600 gpd	Ultimate 289,800 gpd
60 Days @ 100% Max.Day Occupancy	5.48 MG	11.44 MG	17.39 MG
60 Days @ 60% " " "	3.29 MG	6.86 MG	10.43 MG
62.5 Days @ 30% " " "	1.71 MG	3.57 MG	5.43 MG
6 Month Winter Subtotal	10.48 MG	21.87 MG	33.25 MG
	Summer Season (April through Sept.)		
Maximum Day	1st Phase 28,450 gpd	Design 59,450 gpd	Ultimate 90,150 gpd
60 Days @ 100% Max.Day Occupancy	1.70 MG	3.57 MG	5.41 MG
60 Days @ 60% " " "	1.02 MG	2.14 MG	3.25 MG
62.5 Days @ 30% " " "	0.53 MG	1.11 MG	1.69 MG
6 Month Summer Subtotal	3.25 MG	6.82 MG	10.35 MG
TOTAL ANNUAL FLOW	13.73 MG	28.69 MG	43.60 MG
Annual Daily Average Flow = $\frac{\text{Annual Flow}}{\text{365 Days}}$ =	37,600 gpd	78,600 gpd	119,500 gpd

MG = Million Gallons gpd = gallons per day

MEADOW VILLAGE.

	Winter Season (Oct. through March)		
Maximum Day	1st Phase 11,100 gpd	Design 69,700 gpd	Ultimate 128,200 gpd
60 Days @ 100% Max.Day Occupancy	0.67 MG	4.18 MG	7.69 MG
60 Days @ 60% " " "	0.40 MG	2.51 MG	4.62 MG
62.5 Days @ 30% " " "	0.21 MG	1.31 MG	2.40 MG
6 Month Winter Subtotal	1.28 MG	8.00 MG	14.71 MG

	Summer Season (April through Sept.)		
Maximum Day	1st Phase 32,500 gpd	Design 109,150 gpd	Ultimate 185,500 gpd
60 Days @ 100% Max.Day Occupancy	1.95 MG	6.55 MG	11.13 MG
60 Days @ 60% " " "	1.17 MG	3.93 MG	6.68 MG
62.5 Days @ 30% " " "	0.61 MG	2.05 MG	3.48 MG
6 Month Summer Subtotal	3.73 MG	12.53 MG	21.29 MG
TOTAL ANNUAL FLOW	5.01 MG	20.53 MG	36.00 MG
Annual Daily Average Flow = $\frac{\text{Annual Flow}}{\text{365 Days}}$ =	13,700 gpd	56,300 gpd	98,600 gpd

BOTH VILLAGES - COMBINED SYSTEM.

	1st Phase	Design	Ultimate
Total Annual Flow	18.74 MG	49.22 MG	79.60 MG
Annual Daily Average Flow = $\frac{\text{Annual Flow}}{\text{365 Days}}$ =	51,300 gpd	134,900 gpd	218,000 gpd

The maximum daily flow contributed by a combined system serving both villages will occur during the winter. These are estimated as follows:

	1st Phase	Design	Ultimate
Mountain Village - Winter	91,400 gpd	190,600 gpd	289,800 gpd
Meadow Village - Winter	11,100 gpd	69,700 gpd	128,200 gpd
Maximum Daily Flow - Combined System	102,500 gpd	260,300 gpd	418,000 gpd

1.04 QUALITY OF SEWAGE:

Quality of sewage refers to sewage "strength" and is an important feature to the Engineer in the design of sewage treatment facilities. Ordinary domestic sanitary sewage contains about 99.9 percent water. The remaining one-tenth of one percent is composed of organic matter such as human wastes, kitchen wastes, greases, solvents and inorganic matter such as sand and grit. About 60 percent of the sewage solids are dissolved in water and about 40 percent are suspended or carried along by the liquid.

Suspended Solids (SS) in sanitary sewage determines the amount of sludge to be expected at the treatment facility. Another equally important factor in the "strength" of sewage is the Bio-Chemical Oxygen Demand (BOD). This is the amount of oxygen required for the aerobic decomposition of the organic matter in sewage. Water tends to rid itself of organic matter through oxidation under favorable conditions of aeration and temperature. A sewage treatment facility accelerates this process under controlled conditions.

In a given community or development, the wastes discharged from houses, condominiums, hotels, motels, restaurants, commercial buildings, etc., are combined within the sewage systems to produce relatively constant per capita amounts of organic matter, as measured in terms of SS and BOD. The Federal Water Quality Administration's study and report on "Basic Waste Characteristics of Winter Recreation Areas" established per capita contributions of SS and BOD as follows:

SS: Overnight Residents - 0.290 lbs. per capita per day

Day Visitors - - - -- 0.013 lbs. " " " "

BOD: Overnight Residents - 0.173 lbs. per capita per day

Day Visitors - - - -- 0.0135 " " " " "

The above per capita contributions were used to estimate SS and BOD quantities in Table IV following.

TABLE IV - SUSPENDED SOLIDS AND BOD - MAXIMUM DAY CONTRIBUTIONS
(Pounds Per Day)

MOUNTAIN VILLAGE.

	1st Phase	Design	Ultimate
	Winter - Max. Day @ Full Occupancy		
SS	426	889	1352
BOD	257	535	815
	Summer - Maximum Day		
SS	133	281	428
BOD	80	169	257

MEADOW VILLAGE.

	1st Phase	Design	Ultimate
	Winter - Maximum Day		
SS	54	336	620
BOD	32	201	370
	Summer - Maximum Day @ Full Occupancy		
SS	154	521	888
BOD	93	312	531

Using the same occupancy rates used previously for determining average sewage flows, the average daily contributions of SS and BOD are estimated in Table V.

TABLE V - SUSPENDED SOLIDS AND BOD
AVERAGE DAILY CONTRIBUTIONS
(Pounds Per Day)

	First Phase		Design		Ultimate	
	SS	BOD	SS	BOD	SS	BOD
MOUNTAIN VILLAGE.						
Winter Season (Oct. through March)	268	162	560	337	852	513
Summer Season (April through Sept.)	84	50	177	106	269	162
Annual Average	176	106	369	222	560	338
MEADOW VILLAGE.						
Winter Season (Oct. through March)	34	20	212	127	391	233
Summer Season (April through Sept.)	97	59	328	197	560	335
Annual Average	66	40	270	162	476	284
BOTH VILLAGES - COMBINED SYSTEM.						
Winter Season (Oct. through March)	302	182	772	464	1243	746
Summer Season (April through Sept.)	181	109	505	303	829	497
Annual Average	242	146	639	384	1036	622

PART II

SEWAGE COLLECTION SYSTEMS

2.01 GENERAL:

The sanitary sewer collection systems have been designed for the ultimate growth of the areas to be served plus some allowances for expansion beyond these areas. The gravity collector, trunk and outfall lines are sized to handle peak flows expected at the ultimate density. Basis of peak flow design is as follows:

Lateral Collection Sewers - 800% of Average Flow

Interceptor Sewers - - - -- 700% of Average Flow

Main Trunk & Outfall Sewers 500% of Average Flow

The minimum size of gravity sewer pipe will be 8" in diameter except for short stubs or runs to individual structures which may be reduced to 6" diameter.

Grades of gravity sewer lines will be established to provide a minimum velocity of 2 feet per second when flowing full. This velocity has been established as the minimum required to prevent settling of sewage solids.

A minimum depth of 9 feet has been considered for collection sewers to provide basement drainage for structures containing levels below ground. Where no basement construction is planned, the depth to the sewer line may be reduced to about 6 feet.

Types of pipe generally used for gravity sewers in this area are vitrified clay and asbestos-cement, with polyvinyl chloride (PVC) pipe becoming increasingly popular in recent years. Generally, alternate bids are received on the different types of pipe.

Concrete manholes, 4 feet in diameter, are placed at sewer line junctions, grade changes, angle points and at approximately 400 foot maximum spacing to provide access for cleaning and inspecting of the lines as the need arises. Curvilinear lines are acceptable on gravity sewer line construction providing the radius of curvature is more than 100 feet and the deflection of the pipe joints does not exceed that recommended by the pipe manufacturer. Solid covers are recommended on manholes to prevent surface water and silt from entering the system.

2.02 MOUNTAIN VILLAGE COLLECTION SYSTEM:

Drawing P-2 included with this report shows the proposed sanitary sewer collection system layout, both for First Phase and Ultimate development. All collection lines within the village area do not exceed 8" in diameter.

The collection line along the proposed residential lot development between the Mountain Village and the east line of Section 29 is considered a portion of the Mountain Village collection system and is shown on the Site Plan Drawing P-1.

2.03 MEADOW VILLAGE COLLECTION SYSTEM:

The proposed collection system for the Meadow Village is detailed on Drawing P-2. For the purposes of this study, all of the collection lines shown are considered as First Phase construction. However, in the final analysis, some consideration may want to be given to reducing the scope of the First Phase construction by assigning a portion of the collection system serving the residential lots to future construction.

PART III

SEWAGE TREATMENT FACILITIES

3.01 GENERAL:

The degree of treatment to be provided to the wastewaters of any development depends on the location of the development, size and condition of the receiving watercourse and the quantity and strength of sewage to be treated. The Montana State Department of Health is the regulatory body on these matters and determines the degree of treatment required.

A letter dated June 17, 1970, from the Montana State Department of Health has established the following minimum treatment standards for the facilities at Big Sky. A copy of this letter is included in the Appendix of this report.

At Low Water In Receiving Stream

BOD Removal - 95% Minimum

Phosphate Removal - 90% Minimum

Coliform content in effluent - Less than 1,000 per 100 ml.

At High Water in Receiving Stream

BOD Removal - 85% Minimum

Coliform content in effluent - Less than 1000 per 100 ml.

The Health Department also requests that if mechanical treatment facilities are used, a final effluent treatment pond be provided, sized at one acre per 2,000 population equivalent. The purpose of this pond is to provide for better dissipation of chlorine prior to entering the receiving stream and also to provide a buffer zone should any mechanical failure occur at the plant facilities.

In response to the above letter from the Montana State Department of Health, the Federal Water Quality Administration (FWQA) has concurred with the State's standards for this project except that they suggest a limit on coliform counts of 200 per 100 ml. instead of 1000 per 100 ml. They also suggest a limit of 10 to 15 milligrams per liter of suspended solids in the treated waste effluent. A copy of FWQA's letter dated July 28, 1970 to the Montana State Department of Health is included in the Appendix of this report.

3.02 TREATMENT PROCESSES:

Sewage treatment processes are generally classified "primary", "secondary" and "tertiary". Primary treatment, involving sedimentation only can be expected to remove 50 to 60 percent of the suspended solids and 25 to 35 percent of the BOD. Secondary treatment which uses biological processes, may remove 80 to 90 percent of the suspended solids and BOD. Tertiary treatment usually involves filtration of a secondary effluent to remove 95 to 99 percent of the suspended solids and BOD plus nutrient removal and treatment for taste and odor control.

The treatment facilities for Big Sky will not be complete tertiary facilities, but will have to be advanced above the secondary process to achieve the 95% minimum BOD and 90% phosphate removal. For effluents discharged to the receiving stream during low water, sand filtration will be required as the final treatment.

3.03 PHOSPHATE REMOVAL:

A. GENERAL. It is generally agreed that phosphate is one of the most important elements in supporting growth of aquative plants. The subject of aquatic growths in lakes, rivers and streams is receiving increased attention in recent years. The major concern is with the nuisance aspects of the wide variety of aquatic forms in the nutrient ladened receiving streams of waste waters. Aquatic growths become nuisances only when they offend man or interfere with some of his schemes for using water. Such problems are normally related to an over-abundance of the aquatic growths.

The principal methods used for controlling phosphate concentrations in receiving waters have been (1) the diversion of phosphate-rich waters from receiving waters, and (2) the removal of phosphates at their source. The above two methods have been studied for the Big Sky facilities and are presented under alternate treatment methods in this report.

B. GOLF COURSE IRRIGATION WITH PLANT EFFLUENT. Utilizing the treated plant effluent for golf course irrigation would be an effective means of diverting the phosphate-rich wastewater from the receiving stream and thus would avoid the requirement of phosphate removal from the effluent. Studies on wastewater renovation indicate that golf course irrigation with well treated effluent is indeed advisable and justifiable. This method of golf course irrigation is becoming increasingly popular and in many cases the program has been expanded to include water hazards and lakes formed from sewage plant effluent.

The benefits of this method of wastewater disposal may be twofold: (1) a reduction in the application of commerical fertilizers to the golf course would be realized, and (2) an aesthetic value would be realized in the fact that no wastewaters would be discharged directly to the receiving stream.

Several precautions should be taken when irrigating with sewage plant effluent. Some of these are:

(1) Sewage effluent should not be sprayed on domestic water wells or reservoirs or on drinking fountains on the golf course. Special protection should be provided for these facilities.

(2) To protect the general public, the irrigation system valves should be designed so that unauthorized persons cannot open them. Valves and sprinkler heads should be appropriately tagged and colored so as to warn the public that the water is unsafe for drinking.

(3) No cross-connections should be permitted between any pipeline or works which may contain sewage effluent and any pipeline or works to be used for domestic supply.

(4) Spraying of sewage effluent should be done so as to minimize the contact of the public with the sprayed material. Preferably, irrigation should be done during the evenings when the course is not in use.

Plans utilizing golf course irrigation with plant effluent are discussed further under alternate methods of treatment in this section.

C. PHOSPHATE REMOVAL FROM PLANT EFFLUENT. There are several systems used for removal of phosphates from sewage plant effluents, each achieving a degree of success. Among these are biological removal, ion exchange and chemical precipitation. Ion exchange and chemical precipitation are the only methods which continually achieve a high degree of removal. Although much effort has been spent to develop a more economical process, it is generally recognized that chemical precipitation is the most economical of the proven means of high degree phosphate removal.

The chemical precipitation method of phosphate removal involves coagulation of the plant effluent followed by settling facilities and sand filters. The coagulants used for phosphate removal are usually alum, iron salts or lime. The degree of phosphate removal is proportional to the amount of coagulant added and also will vary depending on the chemical characteristics of the wastewater being treated. The use of large coagulant dosages results in massive quantities of chemical sludge. The cost of necessary chemicals is the largest single expense in the chemical precipitation method of phosphate removal, although increased sludge handling contributes greatly to the overall operating costs.

Phosphate removal facilities and costs of operation are discussed further in other sections of this report.

3.04 ALTERNATE TREATMENT AND DISPOSAL PLANS:

A. GENERAL. Two possible alternates have been investigated for collecting and treating the sanitary wastes from the two villages at Big Sky. Alternate I considers separate treatment facilities of each village and Alternate II provides for an interceptor line between the two villages with a single treatment facility at the lower end of the Meadow Village site. Under the single plant concept of Alternate II, three methods of treatment and disposal have been considered, whereas flow conditions, space and other factors limit considerations to one method of treatment for the individual plants of Alternate I.

B. ALTERNATE I - SEPARATE PLANTS AT EACH VILLAGE. Drawing P-1 accompanying this report shows the approximate locations of the individual plants at each village.

Due to the expected fluctuations of sewage flows at the individual developments, "extended aeration" biological plants are recommended at each site. This treatment would be followed by chemical precipitation phosphate removal facilities including flocculation, settling and sand filtering units.

Extended aeration treatment is a dependable mechanical aeration treatment which operates satisfactorily over a wide range of sewage flows without plant upset. The aeration tank is of sufficient size to allow approximately 24 hours aeration at design flows. Several manufacturers are including flocculation, settling and filtering facilities together with the aeration facilities in a "packaged" unit. The packaged facility is attractive for smaller units because of the lower initial cost and the ease in providing additional capacity in the future by paralleling with similar units.

Treatment plant facilities must be sized on the maximum 24 hour sewage flow expected. Referring to Part I of this report, the estimated maximum daily flows are as follows:

	Design Year	Ultimate
Mountain Village-Max.Day	190,600 gpd	289,800 gpd
Meadow Village-Max.Day	109,150 gpd	185,500 gpd

For the Mountain Village it is suggested that two 100,000 gpd units be installed under Phase I construction with a third 100,000 gpd unit added in the future for ultimate capacity. A polishing pond of about one acre would be required with the initial construction and expanded to about 1.5 acres with the future addition.

The Meadow Village would require one 100,000 gpd unit initially with a second unit of equal size added in the future for ultimate capacity. The initial polishing pond would be about 1/2 acre in size, expanding to one acre for ultimate design.

Sewage sludge accumulating from the system plus chemical sludge from phosphate precipitation, would be pumped to sand drying beds for dewatering. Dried sludge would be periodically hauled away and disposed of in a land fill operation or some other suitable means of disposal.

The plant effluent would be chlorinated just prior to entering the polishing pond.

Costs of chemicals and other operating costs are presented later in this report under Part 4, "Cost Estimates".

C. ALTERNATE II - SINGLE TREATMENT PLANT. The location of the single treatment plant to serve both villages would be at the same site as the individual Meadow Village plant site discussed above. Three methods of treatment have been considered: (1) contact stabilization biological treatment with flocculation, settling and filtering facilities for phosphate removal; (2) contact stabilization, settling and filtering facilities without phosphate removal with effluent storage for golf course irrigation, and (3) aerated lagoon followed by filtering facilities for golf course irrigation. Treatment Method No. 1 can be constructed within property owned by Big Sky in Section 36, whereas Methods 2 and 3 require larger area for pond construction and overlap into Section 31, not presently owned by Big Sky.

Maximum daily flow from the combined system serving both villages will occur during the winter season. Estimated flows as presented in Part I of this report are as follows:

	Design Year	Ultimate
Mountain Village-Max.Day Winter-	190,600 gpd	289,800 gpd
Meadow Village-Max.Day Winter-	69,700 gpd	128,200 gpd
Maximum Day-Combined System	260,300 gpd	418,000 gpd

The above maximum daily flow for the design year dictates capacity of mechanical facilities recommended for First Phase construction with future expansion of the plant approximating the flow indicated for ultimate development.

Treatment Method No. 1. For initial construction, this treatment system includes a 250,000 gpd contact stabilization biological plant, chemical flocculation, settling and filtering facilities for phosphate removal sized at 250,000 gpd and a polishing pond of approximately 1.25 acres in size. Figure 1 illustrates a typical layout of this system located at the site adjacent to the proposed silt pond on the West Fork. Future expansion would include the addition of another contact stabilization plant and flocculation, settling and filtering facilities, all sized at approximately 200,000 gpd, bring the total plant capacity to approximately 450,000 gpd. The polishing pond addition in the future would be about one acre in size.

"Contact Stabilization" biological treatment is a modification of the conventional activated sludge treatment process. This proven system mixes well conditioned activated sludge in a contact tank with the incoming sewage which quickly adsorbs and absorbs the organic material in the raw sewage. The detention time is about 1/3 that of an extended aeration plant and requires less aeration time. This system becomes more favorable in sizes larger than that normally used for the extended aeration process. Power requirements for operation are considerably less. Contact Stabilization requires a more balanced flow for proper operation than does extended aeration, however, with combined flow from both villages, it is expected that the fluctuations will be less severe. The settling and filtering facilities following this unit will also assist in smoothening unbalanced plant conditions. In earlier years when operating at low flows the plant can function as an extended aeration unit since the detention time will be increased considerably from that at design capacity.

Sewage sludge would be dried in the sludge drying beds and disposed of in a manner similar to the extended aeration plant process.

Plant effluent would be chlorinated following the filtering process and prior to entering the contact pond. Final effluent from the chlorine contact and polishing pond would be discharged directly to the receiving stream.

Treatment Method No. 2. Figure 2 shows a typical layout of Method No. 2 consisting of contact stabilization and filtration treatment without phosphate removal facilities and effluent storage provided for golf course irrigation. The contact stabilization and filtering facilities are similar to those under treatment Method No. 1 except flocculation and chemical feed equipment for phosphate removal are deleted. Initial facilities recommended for Phase I construction would be sized at 250,000 gpd with the future addition of 200,000 gpd bringing the ultimate plant capacity to approximately 450,000 gpd.

Required storage for golf course irrigation at design capacity is about 30 Million Gallons (MG) increasing to approximately 48 MG at ultimate capacity. This is based on the 6-month winter flows from both villages. See Table III, Part 1 of this report.

Irrigation of golf courses in Montana requires an estimated 0.68 MG per acre per irrigation season. Under normal years, the irrigation season will extend from April through October and sometimes extending into November.

For an 18 hole golf course, the irrigated acreage is estimated to be about 72 acres. Direct ratio of 9 additional holes would bring the total irrigated acreage for a 27 hole course to about 108 acres.

Based on the above criteria, the golf course water requirements for irrigation would be approximately as follows:

18 hole course - 72 acres @ 0.68 MG = 49 MG Per Season

27 " " -108 acres @ 0.68 MG = 74 MG Per Season

Maximum day requirements for an 18 hole course is estimated at 300,000 gpd and about 500,000 gpd for a 27 hole course.

Based on estimated sewage flows in Table III, Part 1, the golf course irrigation balance requirements are shown in Table VI.

TABLE VI
GOLF COURSE IRRIGATION REQUIREMENTS

	1st Phase	Design Year	Ultimate
Total Estimated Annual Flow - Both Villages	18.74 MG	49.22 MG	79.60MG
18 Hole Course Annual Requirements	49 MG	49 MG	49 MG
Plant Effluent Deficit (-) or Balance (+)	-30 MG	-	+32 MG
27 Hole Course Annual Requirements	74MG	74MG	74MG
Plant Effluent Deficit (-) or Balance (+)	-55MG	-25MG	+6MG

Table VI illustrates that during initial years of operation, some makeup water will be required to supplement the sewage plant effluent for golf course irrigation and as the development reaches the ultimate stage, there will be an excess of plant effluent.

Normal operation of the Method No. 2 Treatment Plant would have the effluent storage pond near empty at the end of the golf course sprinkling season. During the winter the pond would store the effluent for the next irrigation season. Should an excess of effluent be expected in the spring, the pond may be lowered by discharging to the receiving stream during the high water period.

The biggest advantage of Method No. 2 Treatment over Method No. 1 Treatment is the elimination of the phosphate removal requirement. Considerable savings would be realized in chemical costs and in sludge disposal work.

Based on a water depth of 10 feet, a water surface area of approximately 9.2 acres would be necessary to provide the initial 30 MG storage in the effluent pond. Including area for dikes, this would represent a total area required of approximately 11.6 acres for the 30 MG pond. To increase the pond to 48 MG in the future, a water surface area of about 14.8 acres and a total area, including dikes, of about 17.8 acres will be required.

The golf course pump station required to pump the effluent from the pond to the golf course sprinkling system is not considered as a part of the treatment facility and the cost of the same is not included in the estimates presented in Part 4.

Treatment Method No. 3. Plant effluent storage requirements for golf course irrigation as presented under Treatment Method No. 2 lends itself to the aerated lagoon method of treatment which beneficially uses this storage volume in treating the sanitary wastes. An aerated lagoon consists of a storage pond with mechanical or diffused aeration facilities to add oxygen to the pond contents to satisfy the BOD.

Figure 3 illustrates a plant layout for an aerated lagoon system. The aerated lagoon consists of two cells of 30 MG total capacity for initial construction with a third cell added in the future to bring the capacity to the ultimate of 48 MG.

Raw sewage is pumped to the aerated lagoon without any prior treatment. No sludge handling, drying or disposal facilities are necessary as the sludge is retained in the pond and is continually being digested and reduced by aeration. It is anticipated that sludge would not have to be dredged from the pond for 50 years or so.

Aeration facilities utilizing diffused air will probably give the best wintertime service at less maintenance. Several types of this system are available, each having their own special features. The appearance of the aerated lagoon in the non-freezing periods would simulate boiling water. During the winter months, the pond may freeze over, but the aeration would continue without interference.

During the summer months it is expected that the aerated lagoon will produce an effluent with solids and BOD reduced by 90 percent or more. This effluent will be drawn from the pond and conditioned further by sand filtering before being pumped to the golf course. A one MG storage reservoir of concrete or steel would follow the filtering facilities. This reservoir would provide about 2 days capacity for the maximum day irrigation requirements for a 27 hole course. Capacity of the filtering facilities for the initial 18 hole course is suggested at 300,000 gpd with expansion to 500,000 gpd in the future for a 27 hole course. The effluent from the filtering facilities would be chlorinated prior to entering the 1 MG storage reservoir.

As in Treatment Method No. 2, the normal operation of the aerated lagoon would have the pond level drawn down to a minimum at the end of the golf course irrigation season. Wintertime flows up to the beginning of the next irrigation season would be stored in the aerated lagoon without overflow.

Treatment Method No. 3 has some distinct advantages over the other proposed methods of treatment. The system is basically less complex than the other systems and would result in less labor for maintenance. The elimination of the sludge handling facilities is another feature which is most desirable.

PART 4

COST ESTIMATES

4.01 GENERAL:

The following cost estimates are based on present day construction costs. Considerable variation in the relative cost of specific items of materials, equipment and service may be expected.

Normally a percentage of the construction cost estimates is allowed for contingencies. However, the planning group has requested that the cost estimates be made as realistic as possible and a contingency allowance has not been included in the following estimates.

The cost estimates also do not include costs for engineering, legal, fiscal or any other fees.

4.02 DETAIL CONSTRUCTION COST ESTIMATES:

A. GENERAL. Estimated sewer pipe construction costs are based on the following criteria.

COST PER LINEAL FOOT

Pipe Size	Pipe Cost	Pipe Installation	Excavation & Backfill	Select Backfill	Total	Use
8''	$1.25	$3.70	$1.33	$0.40	$6.68	$6.70
10''	1.75	3.85	1.33	0.40	7.33	7.35
12''	2.15	4.00	1.33	0.40	7.88	7.90
15''	3.40	4.25	1.33	0.40	9.38	9.40

Pipe line estimates are made on the assumption that no surface finishing is required such as road surfacing. Estimates do not include clearing and grading since it is assumed roads will be graded prior to sewer main construction, but without surfacing.

B. MOUNTAIN VILLAGE COLLECTION SYSTEM.

First Phase

1. 8" Sewer Pipe	10,500 L.F. @ $6.70 =		$70,350
2. Manholes	50 Each @ $450 =		22,500
3. Lampholes	14 Each @ $100 =		1,400
TOTAL First Phase	Collection System		$94,250
		Use	94,000

Balance of Village (Ultimate)

1. 8" Sewer Pipe	10,900 L.F. @ $6.70 =		$73,030
2. Manholes	59 Each @ $450 =		26,550
3. Lampholes	14 Each @ $100 =		1,400
TOTAL - Balance of Village			$100,980
		Use	$101,000

Village to East Line of Section 29

1. 10" Sewer Pipe	12,100 L.F. @ $7.35 =		$88,935
2. Manholes	40 Each @ $450 =		18,000
		TOTAL	$106,935
		Use	$107,000

TOTAL MOUNTAIN VILLAGE COLLECTION SYSTEM $302,000

C. MEADOW VILLAGE COLLECTION SYSTEM.

Alternate I

1. 8" Sewer Pipe	41,100 L.F. @ $6.70 =		$275,370
2. Manholes	113 Each @ $450 =		50,850
TOTAL Collection	System - Alternate I		$326,220
		Use	$326,000

Alternate II

Interceptor Sewer

1. 12" Sewer Pipe	2,200 L.F. @ $9.40 =		$ 20,680
2. 15" Sewer Pipe	7,300 L.F. @ $7.90 =		57,670
3. Manholes	19 Each @ $450 =		8,550
	SUBTOTAL - Interceptor		$ 86,900
		Use	$ 87,000

Remaining Collection System

1. 8" Sewer Pipe	31,600 L.F. @ $6.70 =		$211,720
2. Manholes	94 Each @ $450 =		42,300
	SUBTOTAL - Remaining Collection System		$254,020
		Use	$254,000

TOTAL MEADOW VILLAGE INTERCEPTOR &
COLLECTION SYSTEM - Alternate II - $341,000

D. INTERCEPTOR SEWER BETWEEN VILLAGES (ALTERNATE II).

1. 10" Sewer Main	15,000 L.F. @ $7.35 =	$110,250
2. 12" Sewer Main	15,000 L.F. @ $7.90 =	118,500
3. Manholes	100 Each @ $450 =	45,000
4. Special Structures at Drainage Courses		20,000
	TOTAL	$293,750
	Use	$294,000

E. SEWAGE TREATMENT PLANTS - ALTERNATE I.
(Separate Plants @ Each Village)

Mountain Village - 1st Phase	(200,000gpd)=	$332,000
Mountain Village - Future Addition	(100,000gpd)=	125,000
TOTAL Ultimate Development	(300,000gpd)	$457,000
Meadow Village - 1st Phase	(100,000gpd)=	$205,000
Meadow Village - Future Addition	(100,000gpd)=	125,000
TOTAL Ultimate Development	(200,000gpd)	$330,000
TOTAL - BOTH VILLAGES - ULTIMATE DEVELOPMENT		$787,000

F. SEWAGE TREATMENT PLANTS - ALTERNATE II.
(Single Plant for Both Villages)

Treatment Method 1 - Contact Stabilization & Filtering With Phosphate Removal

1st Phase	(250,000gpd)	$328,000
Future Addition	(200,000gpd)	183,000
TOTAL Ultimate Development	(450,000gpd)	$511,000

Treatment Method 2 - Contact Stabilization & Filtering Without Phosphate Removal - Storage For Golf Course Irrigation

1st Phase	(250,000gpd)	$365,000
Future Addition	(200,000gpd)	200,000
TOTAL Ultimate Development	(450,000gpd)	$565,000

Treatment Method 3 - Aerated Lagoon & Filtering Without Phosphate Removal - Storage For Golf Course Irrigation

1st Phase	(300,000gpd)	$318,000
Future Addition	(200,000gpd)	145,000
TOTAL Ultimate Development	(500,000gpd)	$463,000

4.03 SUMMARY OF CONSTRUCTION COST ESTIMATES:

	1st Phase Construction	Total Ultimate Construction
Alternate I - Separate Treatment Facilities @ Each Village		
1. Mountain Village Collection System	$ 94,000	$195,000
2. Collection System-Mtn. Village to East Line of Section 29	107,000	107,000
3. Meadow Village Collection System	326,000	326,000
4. Mountain Village Treatment Plant	332,000	457,000
5. Meadow Village Treatment Plant	205,000	330,000
TOTAL - ALTERNATE I	$1,064,000	$1,415,000
Alternate II - Combined Treatment Facility For Both Villages		
1. Mountain Village Collection System	$ 94,000	$195,000
2. Collection System-Mtn. Village to East Line of Section 29	107,000	107,000
3. Interceptor Sewer Between Villages	294,000	294,000
4. Meadow Village Interceptor Sewer	87,000	87,000
5. Meadow Village Collection System	254,000	254,000
SUBTOTAL	$836,000	$937,000
Treatment Method 1	$328,000	$511,000
TOTAL ALTERNATE II WITH TREATMENT METHOD 1	$1,164,000	$1,448,000
Treatment Method 2	$365,000	$565,000
TOTAL ALTERNATE II WITH TREATMENT METHOD 2	$1,201,000	$1,502,000
Treatment Method 3	$318,000	$463,000
TOTAL ALTERNATE II WITH TREATMENT METHOD 3	$1,154,000	$1,400,000

4.04 OPERATING COSTS:

Estimated operating costs of the alternate treatment facilities are presented in Table VII below. The operating costs include only costs for power and chemicals. Labor costs are assumed to about about the same for all alternates presented, even though the plants under Alternate I and Method I of Alternate II will require more attention than Methods

2 and 3 of Alternate II. Power costs have been calculated using the present rate schedule of the Montana Power Company assuming separate metering at each facility. Should Big Sky realize a blanket power rate for the entire complex, the following calculated costs would be adjusted downward accordingly.

TABLE VII

ESTIMATED ANNUAL OPERATING COSTS OF SEWAGE TREATMENT PLANTS

	Initial Year	Design Year	Ultimate
Alternate I - Separate Plants @ Each Village			
Mountain Village Plant			
Average Daily Flow	37,600gpd	78,600gpd	119,500gpd
1. Power Costs	$3,000	$4,400	$5,600
2. Chlorine	120	240	370
3. Phosphate Removal Chemicals	830	1,750	2,650
SUBTOTAL-Mtn. Village	$3,950	$6,390	$8,620
Meadow Village Plant			
Average Daily Flow	13,700gpd	56,300gpd	98,600gpd
1. Power Costs	$2,600	$3,600	$4,400
2. Chlorine	50	170	300
3. Phosphate Removal Chemicals	310	1,250	2,150
SUBTOTAL-Mdw.Village	$2,960	$5,020	$6,850
TOTAL-ALTERNATE I - BOTH VILLAGES	$6,910	$11,410	$15,470
Alternate II - Combined Plant For Both Villages			
Average Daily Flow	51,300gpd	134,900gpd	218,100gpd
Treatment Method I - Contact Stabilization & Filtering With Phosphate Removal			
1. Power Costs	$2,650	$3,650	$4,500
2. Chlorine	170	410	670
3. Phosphate Removal Chemicals	1,140	3,000	4,800
TOTAL-Treatment Method 1	$3,960	$7,060	$9,970
Treatment Method 2 - Contact Stabilization & Filtering Without Phosphate Removal - Storage For Golf Course Irrigation			
1. Power Costs	$2,650	$3,650	$4,500
2. Chlorine	170	410	670
TOTAL-Treatment Method 2	$2,820	$4,060	$5,170
Treatment Method 3 - Aerated Lagoon & Filtering Without Phosphate Removal - Storage For Golf Course Irrigation			
1. Power Costs	$2,650	$3,650	$4,500
2. Chlorine	170	410	670
TOTAL-Treatment Method 3	$2,820	$4,060	$5,170

PART 5

SANITARY SEWER DISTRICT AND GOVERNMENT FINANCING

5.01 GENERAL:

With the development of the Big Sky complex, it is very probable that other surrounding lands will also have development potential. In this case there would be certain advantages to the creation of a public sewer district which would service surrounding areas in addition to the Big Sky facilities.

The formation of a public sewer district would also make the project eligible for construction grant funds from the Federal Water Quality Administration. The grant could possibly amount to 30% of the eligible portions, consisting of the treatment plants and the interceptor sewers. Without formation of a public sewer district, these grant funds would not be available to a privately owned facility.

5.02 COUNTY SANITARY SEWER DISTRICT:

Montana Law provides for the creation of a County Sewer District for the purpose of constructing, financing and operation of sewage collection and treatment facilities. The same law also includes water systems under the same provisions.

The administrative body of a County Sewer District is an elected Board of Directors who are resident property owners in the District. The Board of Directors has the power to determine the proposed water or sewer use charges, to determine area assessments or a combination of both, to defray any project costs. The assessments may be on an area or valuation basis. A general manager, selected by the Board of Directors has responsibility for operation and maintenance of the project. The boundaries of a District may be extended at any time by approval of the qualified property holders in the District.

Following is a brief summary of the requirements for formation of a County Sewer District.

A. PETITION. The initial step for formation of the district of specified boundaries is a petition to the Board of County Commissioners. The petition must bear the signatures of at least 10 percent of the registered voters of the area included in the district. Legal notice shall be given at least two weeks before the hearing. The Board of County Commissioners considers the petition and the written and oral statements for the owners of taxable property within the proposed district. The hearings may be held over a period of not to exceed 4 weeks in all. The Board of County Commissioners considers the need for a district and upon approval determines the boundaries.

B. ELECTION TO FORM A DISTRICT. The district is formed upon approval of the majority of votes cast by registered voters who own taxable real property within the boundaries of the district. The election must be held within 60 days of the approval of the above petition by the Board of County Commissioners. Legal notice of the election must begin at least two weeks before the election.

C. ELECTION TO SELECT A BOARD OF DIRECTORS. Within 90 days after the formation of a district is approved, an election must be held to select a Board of Directors of 5 persons. The nominees to be considered must be supported by at least 25 individual certificates of nomination of a specified form. The petitions must be in final approved form no less than 25 days before the election. At least 10 days notice must be given for the election. When more than one director is to be selected, those receiving the highest number of votes are elected.

D. ORGANIZATION OF THE BOARD. The Board selects its officers and appoints a general manager who is responsible to the Board. The general manager has charge of the construction, operation and maintenance of the project with authority to employ assistance and perform other duties delegated by the Board.

E. ELECTION FOR BONDED INDEBTEDNESS. The Board of Directors may call elections to incur bonded indebtedness as required. The amount of the proposed indebtedness and maximum term of the bonds must be stated. Qualified electors owning real property within the district may vote. Approval of more than two-thirds of the votes cast is necessary to incur the indebtedness.

Attorney Joe Gary has reviewed the County Water and Sewer District law as it may be applied to the Big Sky needs and has pointed out a provision in the election of the Board of Directors which cannot be met under present conditions at Big Sky. This provision requires the nominees for the Board of Directors be supported by a minimum of 25 individual certificates of nomination. Individuals signing the nomination petitions must be property holders within the district. At the present time this provision cannot be met and study is continuing by the Attorneys on a method of satisfying this requirement.

5.03 GOVERNMENT FINANCING:

Under the Water Pollution Control Act of 1956, Public Law 660, the Federal Water Quality Administration (FWQA) will provide grants to assist in financing the construction of sewage works. The grant is only available to public systems. The grant available at the present time amounts to 30 percent of the cost of interceptor sewers, outfall sewers and treatment facilities.

From preliminary discussions with the Montana State Department of Health, it was contemplated that only the treatment plants would be eligible under Alternate Plan I, while under Alternate Plan II the eligible portion would probably consist of the treatment facility and the interceptor sewer between the two villages.

Following is an estimate of construction costs considering possible government financing:

	1st Phase Construction	Total Ultimate Construction
Alternate I - Separate Treatment Facilities @ Each Village		
Eligible For FWQA Grant:		
Mountain Village Treatment Plant	$332,000	$457,000
Meadow Village Treatment Plant	205,000	330,000
Total Eligible	$537,000	$787,000
30% Grant---------------Say	161,000	236,000
Balance	$376,000	$551,000
Balance Construction Costs Not Eligible (See Section 4.03)	527,000	628,000
NET COST TO OWNER	$903,000	$1,179,000

	1st Phase Construction	Total Ultimate Construction
Alternate II - Combined Treatment Facility For Both Villages		
Interceptor Sewers Eligible:		
Interceptor Sewer Between Villages	$294,000	$294,000
Meadow Village Interceptor Sewer	87,000	87,000
Total Interceptor Eligible	$381,000	$381,000
Treatment Plant - Method 1 -	$328,000	$511,000
Total Eligible	$709,000	$892,000
30% Grant---------------Say	213,000	268,000
Balance	$496,000	$624,000
Balance Construction Costs Not Eligible (See Section 4.03)	455,000	556,000
NET COST TO OWNER	$951,000	$1,180,000
Treatment Plant - Method 2 -	$365,000	$565,000
Total Eligible	$746,000	$946,000
30% Grant---------------Say	224,000	284,000
Balance	$522,000	$662,000
Balance of Construction Costs Not Eligible	$455,000	$556,000
NET COST TO OWNER	$977,000	$1,218,000
Treatment Plant - Method 3 -	$318,000	$463,000
Total Eligible	$699,000	$844,000
30% Grant---------------Say	210,000	253,000
Balance	$489,000	$591,000
Balance of Construction Costs Not Eligible (See Section 4.03)	$455,000	$556,000
NET COST TO OWNER	$944,000	$1,147,000

The above figures are based on construction costs only. Other project costs such as legal, fiscal, engineering fees and other miscellaneous administrative costs are eligible for the FWQA grant and would be added to the above.

PART 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This report has presented two alternate plans for the location of the sewage treatment facilities. Alternate Plan I considers a separate treatment facility at each village. The facility at each village would provide phosphate removal facilities with the sand filtered effluent discharged to a small polishing and chlorine contact pond prior to discharge to the receiving stream. Alternate Plan II provides a single treatment facility at the Meadow Village to serve both villages with the sewage transported from the Mountain Village to the Meadow Village site by an interceptor sewer connecting the two systems. Three methods of treatment have been considered for the treatment facility under Alternate Plan II. Treatment Method No. 1 involves phosphate removal by chemical precipitation, sand filtering and polishing pond treatment prior to discharge to the receiving stream. Treatment Methods No. 2 and 3 do not provide for phosphate removal and utilize the plant effluent for golf course irrigation, without any discharge to the receiving stream. Method No. 2 provides for storage of the treated and filtered effluent for irrigation whereas Method No. 3 utilizes an aerated lagoon for both storage and treatment with the effluent sand-filtered prior to discharge to the golf course.

Construction costs for Alternate Plan II are slightly higher than for Alternate I for First Phase Construction. However, Alternate II with any one of the three methods of treatment considered has two distinct advantages over Alternate I. These are: (1) Operation and maintenance of the single treatment facility is considerably less than the two separate facilities, and, (2) The connecting line between the two villages can provide for future service at little cost to a vast amount of area located between the villages.

Of the three methods of treatment under Alternate Plan II, Method No. 3 utilizing the aerated lagoon offers the least construction cost and operating costs. Treatment Method No. 1 facilities can be constructed within the confines of property presently owned by Big Sky, whereas Methods No. 2 and 3 utilizing storage for golf course irrigation require additional property in Section 31, not presently owned by Big Sky.

Golf course irrigation with the sewage plant effluent is practical and feasible. It offers aesthetic values by not directly discharging sewage plant effluent to the receiving stream and provides a savings in the application of commercial fertilizers to the golf course.

All treatment processes and facilities proposed in this study will provide the required quality of plant effluent as stipulated by the Montana State Department of Health and the Federal Water Quality Administration. Based on construction and operating costs as well as aesthetic benefits, it appears that Alternate II with Method 3 treatment with aerated lagoons will be the best solution for the Big Sky operations. The recommendations are, therefore, that Big Sky give due consideration to obtaining the necessary property in Section 31 in order that Treatment Method 3 under Alternate Plan II may be utilized.

APPENDIX

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JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

State of Montana

State Department of Health

HELENA, MONTANA

June 17, 1970

RECEIVED
JUN 18 1970
MORRISON-MAIERLE

Mr. Willis Wetstein
Morrison-Maierle, Inc.
910 Helena Avenue
Helena, Montana 59601

Dear Mr. Wetstein:

This is in reference to our discussion on minimum treatment requirements for the Big Sky recreational complex on the West Fork of the Gallatin River.

For any sewage discharged during low water, we are requesting a minimum BOD reduction of 95 percent, minimum 90 percent phosphate removal, and a coliform content of less than 1,000 per 100 ml. If a mechanical treatment plant is used, we request that a pond with a minimum size of one acre per 2,000 people be provided as final effluent treatment.

Any wastes discharged during high water should have a minimum BOD reduction of 85 percent and a coliform content of less than 1,000 per 100 ml. The final disposal point of the sewage should be determined after the needed stream measurements are made in the area. We recommend that stream gaging stations be established at any of the points where you are proposing to discharge sewage so flow information can be obtained before final design is made.

We feel that the above treatment will permit the development to meet the anti-degradation clause of the State's Water Quality Standards. Being the discharge point will probably be close to an interstate stream, we are sending a copy of this letter to the Federal Water Quality Administration for their comments.

Sincerely yours,

D. G. Willems

D. G. Willems, P.E., Chief
Water Pollution Control Section
Division of Environmental Sanitation

DGW:vme

cc: City-County Health Department, P. O. Box 639, Bozeman, Montana
Federal Water Quality Administration, Pittock Black, Room 501, Portland, Oregon

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION
911 Walnut Street, Room 702
Kansas City, Missouri 64106

IN REPLY REFER TO:
Regional Director
(E-SC)

July 28, 1970

Mr. C. W. Brinck, Secretary
Montana Water Pollution Control Council
Division of Environmental Sanitation
Montana State Department of Health
Laboratory Building
Helena, Montana 59601

Dear Mr. Brinck:

On June 17, 1970, your office mailed a copy of Mr. D. G. Willems' letter to Mr. Willis Wetstein, Morrison-Maierle, Inc., to the Regional Director, Northwest Region, Federal Water Quality Administration. The Regional Director forwarded the copy of the letter to our office for comments because the project under discussion is in the Missouri River Basin drainage.

The Big Sky development will undoubtedly induce much future development. Since actions taken now may well establish precedent, we feel that stringent waste treatment requirements are in order to protect the high quality streams both now and in the future.

The minimum biochemical oxygen demand (BOD) and phosphate removals indicated in your letter appear satisfactory providing the receiving stream flows are adequate. We suggest that you establish a limit on suspended solids as chlorination is much more effective when the suspended solids are low. We suggest a limit of 10 or 15 mg/l suspended solids in the treated waste effluent.

As the treated wastes will be discharged to relatively high quality waters, we suggest that lower coliform densities be considered. We therefore recommend that you limit the total coliform counts to 200 per 100 ml.

Additional safeguards must be considered when chlorinated wastes are discharged to low flow streams. Fish, especially trout, are extremely sensitive to chlorine and small concentrations can be lethal. Therefore, after chlorinating to reduce coliform concentrations, we recommend that some means be specified to deplete the residual chlorine before discharge to the receiving waters.

CLEAN

Mr. C. W. Brinck
July 28, 1970
Page 2

In your letter to Mr. Wetstein you specify treatment requirements during "low water" and "high water" flows. These flows should be defined.

We appreciate having the opportunity to comment on treatment requirements for this project while it is in the early p[illegible] to discuss this with you further as more informati[illegible]ie.

Yours very truly,

JOHN M. RADEMACHER
Regional Director

cc: State Health Officer